

PUFFINUS NUGAX (Solander).

PROCELLARIA CÆRULEA, Gm.

Both species breed in the mountainous parts of the islands; and my son obtained a specimen of the former, swimming on the Rewa river.

PHAËTON ÆTHEREUS, L.

PHAËTON RUBRICAUDA, Bodd.

PHAËTON CANDIDUS, Gray.

I have positively identified these three *Phaetontes* as inhabitants of these islands.

DIOMEDEA MELANOPHRYS.

Baron von Hügel testifies that he saw this bird within sight of Kandavu; it may therefore claim a place in our avifauna.

8. On some Anatomical Characters which bear upon the Major Divisions of the Passerine Birds.—Part I. By A. H. GARROD, M.A., F.Z.S., Prosector to the Society.

[Received May 17, 1876.]

(Plates XLVIII.—LIII.)

A special analysis of the peculiarities of structure presented by different Passerine birds can hardly be considered premature. Since the investigations of Nitzsch, Sundevall, Keyserling and Blasius, Johannes Müller, and Cabanis little of decided importance has been made out with reference to the distinguishing characters of the group or of its primary divisions, if we except the researches of Professors Huxley and Parker on the palate in the class Aves generally. A glance at the history of the Order will be the best introduction which I can offer to the facts which it is my desire upon the present occasion to bring before the Society.

Although the name "Passeres" was coined by Linnæus, that illustrious naturalist did not appreciate the unity of the group, his classification compelling him to include the Columbæ in the order, which was defined as having "rostrum conico-attenuatum," and *Paradisea*, *Corvus*, together with *Certhia* among the "Picæ," "rostro superne compresso convexo."

Cuvier, in 1798*, made a great step in advance by forming an order "Passeres" to include all those now so called, together with those non-swimming, non-wading, non-climbing, non-raptorial, non-gallinaceous birds in which there are not two toes of the foot retroverted.

Nitzsch† was the first to appreciate the true limits of the order, when in 1829 he grouped together the birds now termed PASSERES in a single section, entirely by themselves.

* Tableau Élémentaire, p. 199 *et seq.*

† Observationes de Avium arteriâ carotide communi.

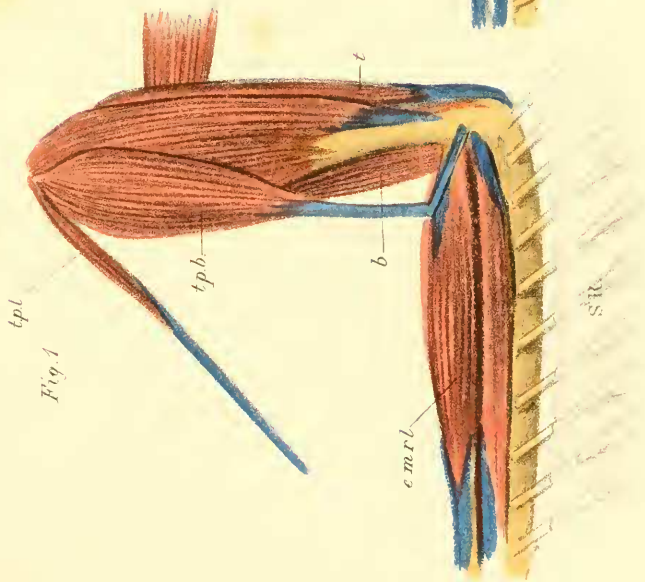


Fig. 1

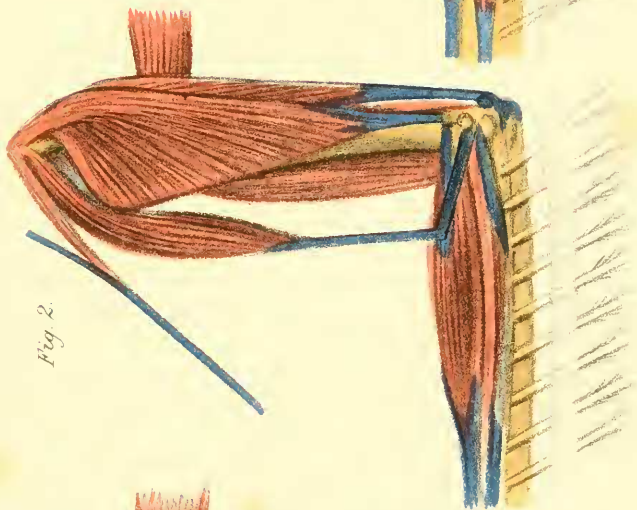


Fig. 2

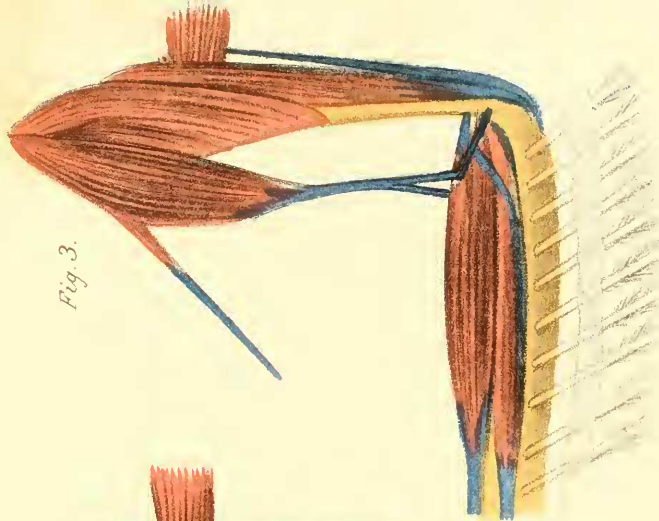


Fig. 3

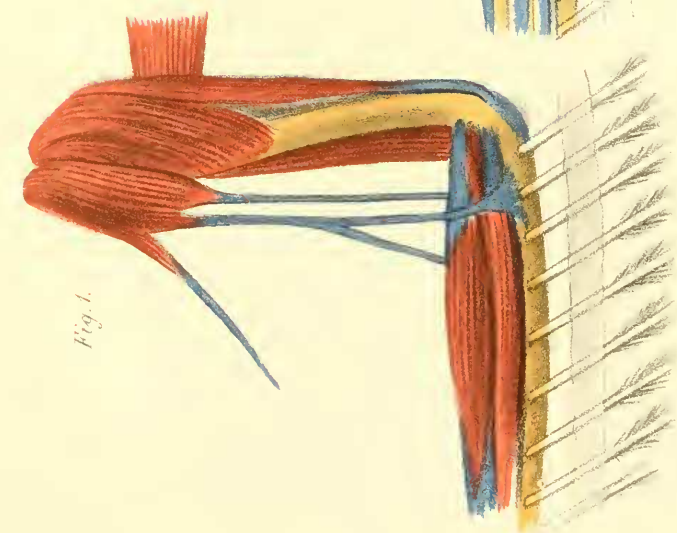


Fig. 1.

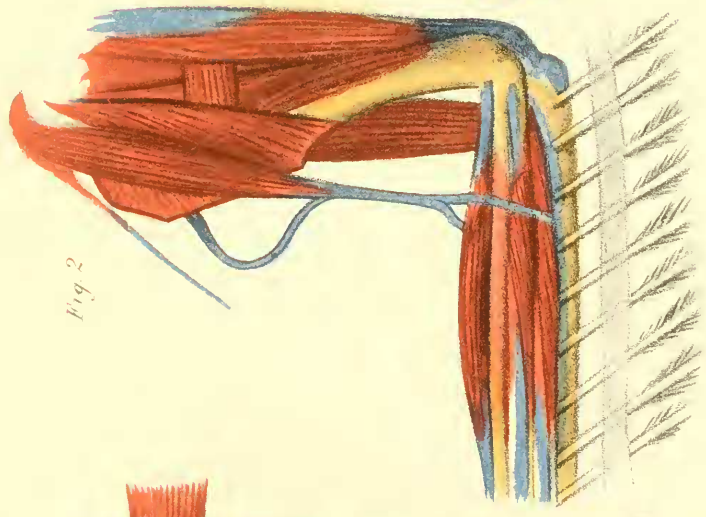


Fig. 2.

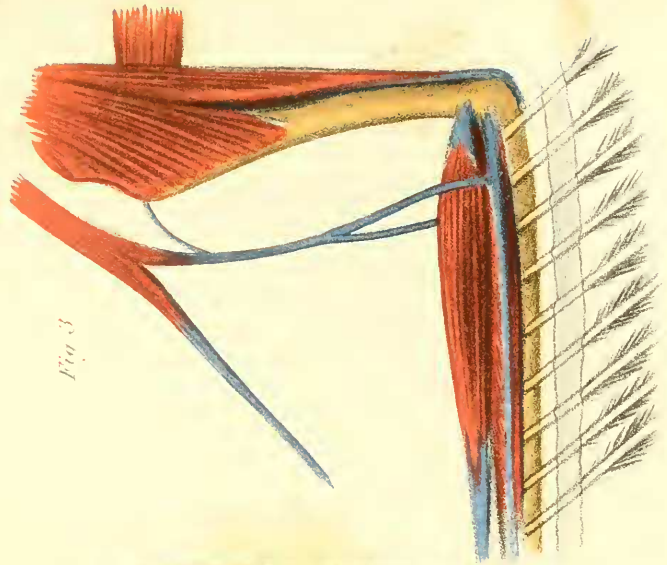


Fig. 3.

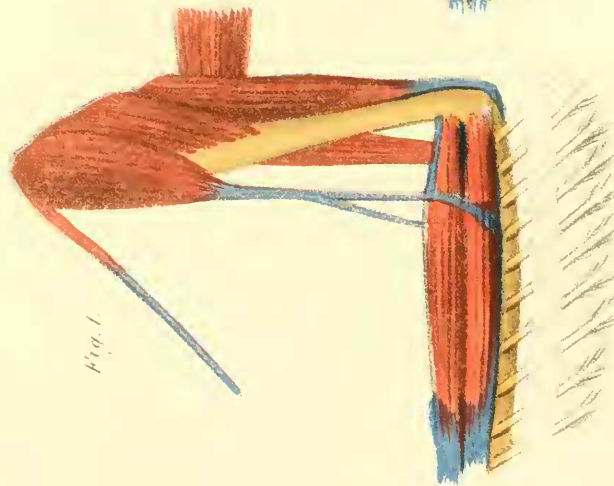


Fig. 1

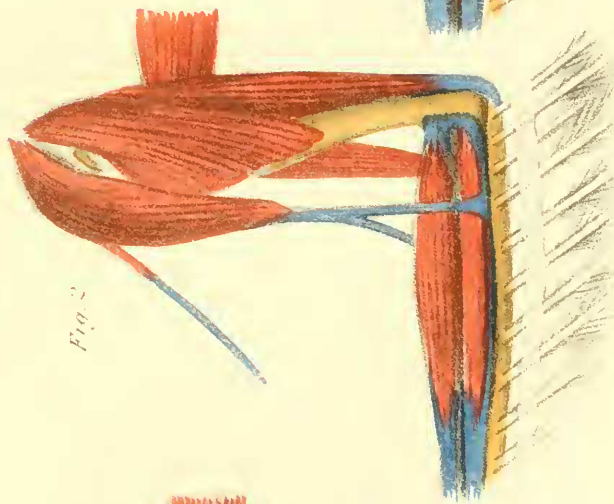


Fig. 2

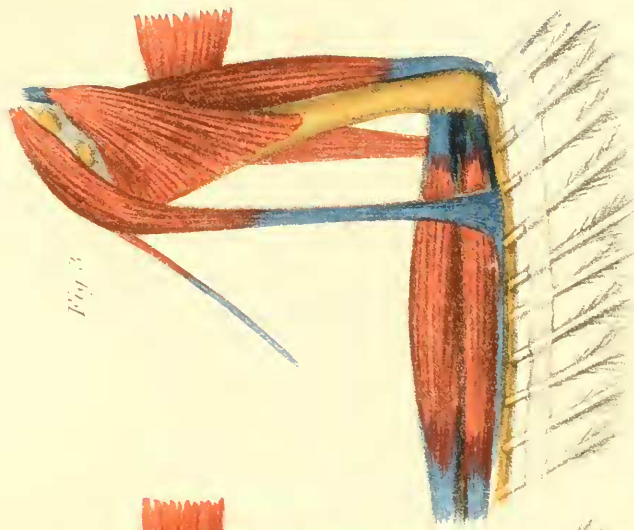


Fig. 3

Fig 1.

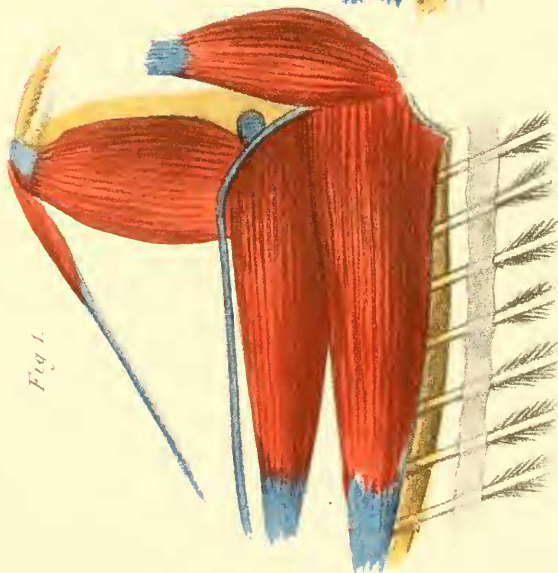


Fig 2

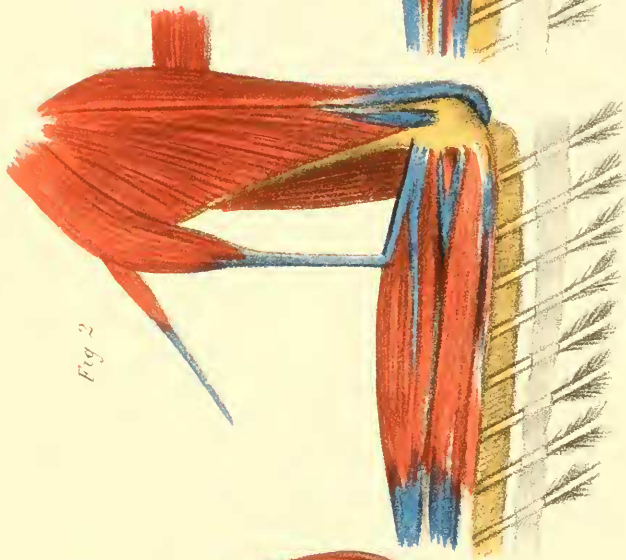
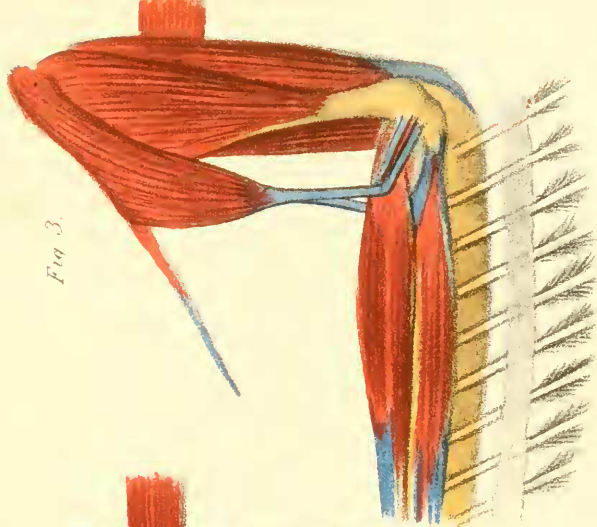


Fig 3.



J Smit lith.

Hanhart imp.

ANATOMY OF PASSERINE BIRDS

Fig. 2.

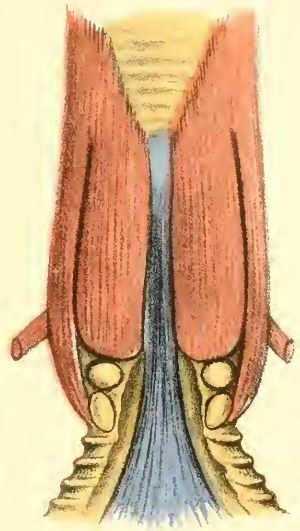


Fig. 1.

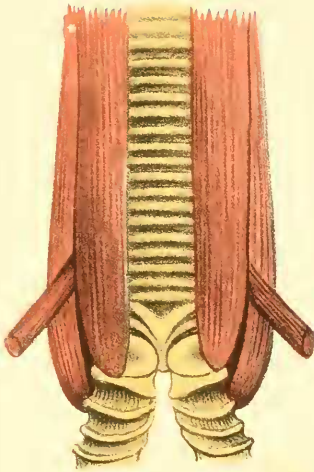


Fig. 3.



Fig. 5.

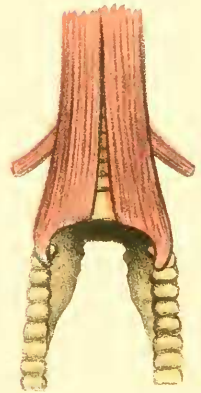


Fig. 4.



Fig. 6.



Fig. 7.



J.Smit lth.

Hanhart imp

Fig. 1.



Fig. 2.



Fig. 3.



Fig. 7.



Fig. 8.



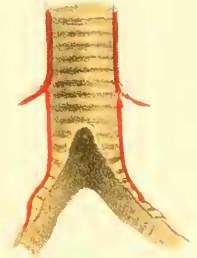
Fig. 4.



Fig. 5.



Fig. 6.



Smit lith

Hanhart imp

C. J. Sundevall, in 1831, discovered that in the birds which he had the opportunity of examining that belonged to the order Passeres of Nitzsch, and only elsewhere in *Upupa*, the tendon of the *flexor longus hallucis* is quite independent of the *flexor perforans digitorum pedis*, a bond of union of one kind or other * joining them in other birds.

Keyserling and Blasius†, in 1839, established the law that (with the exception of the Alaudidæ) those Passerine birds in which the form of the lower larynx (named "syrinx" by Professor Huxley) is what is known as "oscine," possess a pair of long scutes as a covering to the back of the tarso-metatarses. They may therefore be called *bilaminate*, to facilitate description, the term referring to the tarsal scutellation only.

Johannes Müller‡, from his elaborate investigations on the structure of the syrinx in the South-American Passeres, was led to divide the group into two major sections—those in which the intrinsic muscles of the voice-organ are inserted into the ends of the bronchial semi-rings, and those in which they are inserted into their middle parts. I would suggest the name *Acromyodi* for the former of these divisions, and *Mesomyodi* for the latter—an acromyodian bird being one in which the muscles of the syrinx are attached to the extremities of the bronchial semi-rings, a mesomyodian bird being one in which the muscles of the syrinx join the semi-rings in their middles. It seems to me advisable to restrict these terms to Passerine birds.

Müller found that among the mesomyodian Passeres there is a large collection of genera in which an easily recognized special type of syrinx exists. This group he separated off as "Tracheophonæ," so naming them on account of the large share taken by the peculiarly modified lower end of the trachea in the formation of the voice-organ. In one respect he made a retrograde step, because he did not lay sufficient stress upon the value of Nitzsch's work; and this was that he united the mesomyodian Passerine birds which are not tracheophone with those families which constituted the more expanded "Passeres" of Cuvier and with the Scansores, wavering between the two classifications, which may be expressed, with the employment of the term introduced above, as follows:—

- | | |
|---|---|
| 1. PASSERES ACROMYODI (Oscines). | 1. PASSERES ACROMYODI (Oscines). |
| 2. PASSERES MESOMYODI TRACHEOPHONI. | 2. PICARLE. |
| 3. PICARLE. | a. Passeres mesomyodi |
| a. Passeres Mesomyodi non-tracheophoni. | tracheophoni. |
| &c. | b. Passeres mesomyodi non-tracheophoni. |
| | &c. |

From the above remarks it is evident that Müller was led to lay too great stress upon the nature of the syrinx as a distinctive feature of the Passeres; and although Nitzsch was unacquainted with the

* *Idiæ Methodi naturalis Avium disponendarum Tentamen*, 1872, p. xl.

† Wiegmann's 'Archiv,' 1839, i. p. 332.

‡ Abhand. d. Berl. Akad. 1846, p. 367.

existence of the mesomyodian voice-organ, there can be scarcely any doubt that had he lived subsequently to Müller he would never have separated its possessors off from their oscine allies, considering that he had fundamental palatal and pterylographic characters to fall back upon.

The investigations of Macgillivray* and others have made it evident that colic cæca (of small size) are present in all true Passerine birds; and this fact, when correlated with the universal presence of a nude coccygeal oil-gland, has led me † to place them in near relationship with those other Cuvierian Passeres (the Cuculidæ excepted) in which the oil-gland is nude and cæca coli are always present—away from the remainder of his group, in which no cæca are developed and the oil-gland is tufted. The Passeriformes and Piciformes thus defined, all wanting the ambiens muscle across the knee, are included in my major division of the *Anomalogonatae*.

Taking the summation of the characters above referred to, in association with others too well known to require special mention, the PASSERES may be defined as those Anomalogonatous birds with the 2nd, 3rd, and 4th toes of the foot directed forwards, and the hallux backwards, in which the *flexor longus hallucis* muscle is independent of the *flexor perforans digitorum*, the colic cæca are short, the oil-gland nude, at the same time that it is of a characteristic shape, and the palate ægithognathous ‡.

Among the Anomalogonatae there are three toes directed forwards in the Bucerotidæ, Alcedinidæ, Coliidæ, Upupidæ, Coraciinæ, Momotinæ, Caprimulgidæ, and Meropidæ; the *flexor longus hallucis* is free from the *flexor perforans digitorum* in the Upupidæ; colic cæca are present in the Caprimulgidæ, Coraciinæ, Momotinæ, Galbulidæ, Trogonidæ, Meropidæ, and almost certainly so in the Buconidæ, in which families also the oil-gland is nude; the palate is ægithognathous in *Thinocorus*, *Turnix*, and the Cypselinæ, nearly so in the Caprimulgidæ and Trochilinæ.

My investigations into the myology of birds have supplied me with another character of great practical value, which, though in one or two cases slightly disguised, is never found in any but veritable Passeres. It is a peculiarity in the method of insertion of the tendon of the *tensor patagii brevis* of the wing.

In the triangular patagium of the wing of the bird the tendons of two muscles are to be found. One is that of the *tensor patagii longus*, which forms the supporting cord of the free margin of the membrane itself. The second is that of the *tensor patagii brevis*, which courses parallel with the humerus, not distant from that bone, to the muscles and fasciæ of the forearm. In the Ramphastinæ, Capitoninæ, and Picinæ, where this muscle is less complicated than in any other birds, it arises, as is generally the case, from the apex of the upper of the two processes at the scapular extremity of the furcula, as well as by a small special slip from the superficial fibres of the *pectoralis major* muscle, which differentiates itself off from

* Audubon's Ornithological Biography, 1838. † P. Z. S. 1874, p. 119.

‡ Prof. Huxley, "Classification of Birds," P. Z. S. 1867, p. 456.

the main muscle near the upper part of its inserted extremity. The comparatively insignificant triangular or compound fleshy belly thus formed, with its apex directed towards the elbow, terminates in a cylindrical tendon, which, included between the layers of the fibrocutaneous patagium, takes a straight course to its insertion into the axially-running tendon of origin of the *extensor metacarpi radialis longus* of Schöppss, at a short distance from the tubercle on the humerus whence the muscle springs.

As a result of this disposition, when the forearm is half-flexed, the tendon of the *tensor patagii brevis* is seen to enter the substance of the fibrous origin of the *extensor met. rad. longus*, and at right angles. This arrangement is indicated in Plate XLVIII. fig. 1, and is characteristic of the Picariæ, as defined by myself to include the three subfamilies above referred to and them only*.

Among the Passeres a slight, but easily recognizable, difference in the manner of insertion of the muscle maintains. The similarly single cylindroid tendon runs from the muscular belly, which has its origin at the shoulder, as above described, to the upper margin of the *extensor met. rad. longus* muscle, at an exactly similar spot: it does not, however, simply blend with the fibrous origin of that muscle; it becomes attached to it at the spot indicated, and then (again considering the forearm as half bent upon the humerus) runs back *independently* to be attached to the base of the tubercle of origin of the *extensor met. rad. longus*, slightly below that muscle's springing-point. As a consequence of this arrangement there are two tendons to be seen running to one spot (that on the upper margin of the *extensor met. rad. longus*, where the tendon of the *tensor* meets it) from two points, one the apex of the tubercle on the humerus above referred to, and the other, the depression at its base. These tendons therefore converge as they leave the elbow, having at first an appreciable interval between them, which is gradually diminished as they approach, although they remain quite free from one another, that of the *tensor* being superficial. A glance at Plate XLVIII. fig. 2, will serve to make this more clear.

I have had the opportunity of looking at this muscle in nearly 150 species of Passerine birds, belonging to nearly all the most important sections. I first observed it in *Pitangus sulphuratus*, and shortly afterwards recognized the same arrangement in *Hirundo urtica*. A Humming-bird (*Patagona gigas*) and a Swift (*Cypselus apus*) coming to hand at about the same time (the former through the kindness of Professor Newton) impressed me with the distinction between the Macrochires and the Swallows, as far as these elbow-muscles are concerned. Thus stimulated by the significance of the character, I have since taken every opportunity at my disposal to test its importance, the result being very favourable. Among the more aberrant genera I have examined are

* P. Z. S. 1874, p. 123.

<i>Struthidea,</i>	<i>Pitta,</i>	<i>Cotinga,</i>
<i>Heteralocha,</i>	<i>Rupicola,</i>	<i>Furnarius,</i>
<i>Dicrurus,</i>	<i>Lipangus,</i>	<i>Picolaptes,</i>
<i>Prothemadera,</i>	<i>Tyrannus,</i>	<i>Thamnophilus,</i>
<i>Melanocorypha,</i>	<i>Chasmorhynchus,</i>	<i>Grallaria,</i>
<i>Strepera,</i>	<i>Pipra,</i>	<i>Pteroptochus,</i>
<i>Menura,</i>	<i>Tityra,</i>	<i>Hylactes.</i>
<i>Atrichia,</i>	<i>Hadrostromus,</i>	

The only apparent exceptions I have found are the following. In *Pteroptochus albicollis* and in *Hylactes megapodius* the muscular fibres of the *extensor met. rad. longus* almost surround and enclose the tendons in question. Such being the case, the arrangement does not at first sight appear typically Passerine. Nevertheless, upon removing or pushing to one side these covering fibres, the two tendons are seen arranged exactly as in other members of the Order.

In *Menura superba* and in *Atrichia rufescens*, feeble-winged birds again, the arrangement is not typical, and the disposition of the parts is almost exactly as in the Pici, as above described. In other words there are not two tendons, one only being found, simple and broad, apparently produced by the blending of the two. Plate LI. fig. 2 represents the elbow-region of *Menura* as seen from its outer side.

All other Passerine birds which I have examined follow the single type, differing only in the angular divergence of the tendons, their humeral attachments being much separated in most Sturnidæ, Gymnorhinæ, and Tyrannidæ for example, but closely approximated in *Tropidorhynchus*, *Rupicola*, and others.

A short review of the peculiarities of the insertion of the *tensor patagii brevis* muscle in other birds will tend to render the importance of the character more clear, and may add some facts of interest in an ornithological point of view; for it is not in the least difficult for any one who has compared these structures in the various orders of the class to decide by an inspection of the outer surface of the elbow to which division any specimen belongs; and for the satisfaction of those naturalists who consider it essential that characters of importance should be verifiable on all occasions, it may be mentioned that from almost any skin it is possible to decide the point by soaking it, or the wing alone, in cold water, and carefully removing the tegument thus relaxed. On the present occasion the arrangement in the Anomalognatæ will also be almost solely discussed, although among the Homalognatæ characters of nearly equal significance are attainable, somewhat diminished in clearness in some cases by the diffused state of the tendons.

In the Galbulidæ, as represented by *Galbula albirostris* and *Urogalba paradisea* (spirit-specimens of both of which genera have been kindly placed at my disposal by Mr. Salvin), the tendon of the short *tensor* is simple, or it splits slightly before it meets the metacarpal extensor (where the distal moiety there terminates). Its main continuation sends back to the outer side of the lower end of

the humerus a free fasciculus exactly like that above described in the Passeres, except that from about the middle of its lower margin a thin slip runs downwards and wristwards to the fascia of the ulnar side of the outer surface of the forearm. This is represented in Plate L. fig. 1.

In the Meropidæ, as represented by *Merops apiaster* and *M. ornatus*, the only difference from the Galbulidæ is that the distal branch is more clearly differentiated, and the slip to the ulnar side of the forearm is nearer the angular bend. This arrangement is represented in Plate XLVIII. fig. 3. In *Todus viridis* the tendons are similarly disposed.

In the Coraciidæ, as represented by *Coracias garrula* and a species of *Eurystomus* which was not in sufficiently good condition to be more definitely determined, Plate XLIX. fig. 1 represents the distribution of the tendons, there being two parallel to one another, the anterior one of which runs to the superficial ulnar fascia before terminating, and sends wristwards a slip, like that in the Meropidæ, to the long *extensor*. There is a Passeriform free tendon running back to the lower end of the humerus from the outer tendon.

In the Momotidæ the condition is the same, except that the outer tendon does not split, and therefore sends forward no wristward slip. This condition I have found in *Momotus lessoni*, in *M. æquatorialis*, and in *Eumomota superciliaris*. The extension onto the ulnar superficial fascia springs from the portion of the horizontal tendon intermediate between the points of junction of the two parallel long tendons, and is not a direct continuation of either. It is frequently very thin.

In the Trogonidæ, as exemplified by *Trogon mexicana*, *T. puella*, and *Pharomacrus mociano*, the condition is very complicated. It is seen in Plate LI. fig. 3. A superficial long muscular mass runs nearly to the long *extensor* of the forearm. It has a short broad tendinous insertion into the fascia of the outer surface of the forearm; and this is specially developed in a line running back to the humerus in a Passeriform manner. Deep of this are two parallel tendons: the one nearer the humerus terminates exactly like the single one of the Passeres; that further off ends as in the Pici above described.

In the Caprimulgidæ, as found in *Caprimulgus europæus* and *Chordeiles texensis* the arrangement is almost exactly the same as in the Meropidæ. The second outer tendon, however, is shorter.

In the Macrochires, including the Trochilidæ and the Cypselidæ, as found in many genera and species the arrangement is uniform. The fleshy belly runs on to a special tendon which springs from the lower end of the outer surface of the humerus (where the horizontal slip in the Passeres terminates), and is continued, parallel to the forearm, along the radial margin to the hand. Plate LI. fig. 1 exhibits this condition. It can be here seen that the tendon of the *tensor patagii brevis* is not developed, being replaced by the fleshy continuation of the muscle.

In *Upupa epops* the arrangement is fairly simple. The main tendon runs past the free lateral margin of the long *extensor* to the

ulnar superficial fascia, where it becomes lost. It sends forwards a fasciculus from about its middle, to end like the similar band in the Meropidæ. It is figured in Plate L. fig. 2. Its difference from the Passerine arrangement is well-marked.

In the Bucerotidæ, as found in several species of *Buceros*, *Toccos*, and *Bucorvus*, the only difference from *Upupa* is that the extra outer fasciculus is very much shorter, as seen in Plate XLIX. fig. 2. The lengthy tendon from the major pectoral, which is particularly large, is represented.

In the Alcedinidæ the differences are so considerable in the several genera that I reserve the description of the muscle in this order for a future occasion.

As the Cuculidæ and Musophagidæ are frequently included together with the families above referred to, the arrangement of the short tensor in these birds is represented in Plate L. fig. 3 and in Plate XLIX. fig. 3. In all the Cuculidæ the undivided tendon runs on to the ulnar superficial fascia without any complication. In the Musophagidæ the whole tendon is comparatively feeble, and, if it were more definite at its margins, would be exactly like that in *Upupa*.

Next, with reference to the division of the order Passeres into minor sections.

Four or five pairs of muscles running to the ends of the topmost three bronchial semirings constitute the Oscine syrinx, the distinctive features of which are therefore its acromyodian and complex nature. MM. Keyserling and Blasius were the first to associate with this the bilaminar planta—an exception to which occurs in the case of the Alaudidæ, as we all know, these birds possessing a divided planta together with an Oscine syrinx. Mr. Selater has kindly referred me to a paper by Mr. Strickland* on *Heteroenemis nœvia* (there called *Holocenemis flammata*), in which it is shown that in that Formicarian bird the character of the planta is indistinguishable from that of the bilaminar Oscines. With reference to this and closely allied genera it must be noted that the scutellation of the front of the tarsus is also obliterated, so that the simplicity of the planta is only a participation of the condition which maintains in the tarsus generally. Therefore, with this exception (which from its associations can hardly be looked upon as such), it may be said as yet that *no bird which is not acromyodian has a bilaminar planta*.

Nevertheless the law enunciated by Cabanis, to the effect that when in a Passerine bird possessing ten primary remiges the first is very long, then that bird is not Oscine (or Acromyodian), but "Clamatorial" (or Mesomyodian), led that able ornithologist to place *Pitta* in the latter group, although it possesses a bilaminar planta; since which time Johannes Müller is not the only biologist who has wished to know the nature of the syrinx of that bird, of which Sundevall†, in 1872, remarks, "*musculi laryngis inferioris ignoti*."

* Annals and Mag. Nat. Hist. 1844, vol. xiii. p. 415.

† Method. nat. Av. disp. Tentamen, 1872, p. 5.

Through the kind permission of Dr. Günther I have had the opportunity of dissecting two specimens of each of two species of the genus *Pitta*, namely *P. cyanura* and *P. angolensis*, from the National Collection; and Mr. Sharpe had previously very liberally given me a specimen of the Javan species, the dissection of which had led me in my paper "On the Carotid Arteries of Birds" to remove it from the Oscines*, as Cabanis had done from its wing-characters. Two specimens of *Pitta angolensis* from Fantee, and three of *P. cyanura* from Java, have therefore formed the material for the present description.

In *Pitta angolensis* the unmodified trachea terminates thoracically in a ring, split behind, and deep in front; which, from the fact that it presents irregularly placed fenestræ on its anterior surface, arranged in a somewhat transversely linear manner, appears to have been formed by the fusion of two rings. This terminal segment of the trachea does not, as in the Oscines and several other Passeres, form a three-way piece, because there is no antero-posterior bar traversing its inferior margin in the middle line. Of this, however, there is an indication in the form of a median backward-directed process, which advances a short distance into the inferior membriform completion of the tube, from its anterior border. The tracheal ring last but one is complete, and has a slight median indentation in its inferior margin behind. These points are seen in Plate LIII. figs. 1, 2, & 3.

The first and second bronchial ring-segments are semirings—not modified into the somewhat separate, round-margined, slightly oblique semicircles of fibro-cartilage or bone which, as usual, are found nearer the lungs, but are like moieties of true tracheal rings, approximate, sharp-edged, and at right angles to the axis of the tube. They present no peculiar processes, and are slightly swollen at their anterior extremities.

There is only a single pair of bronchial muscles, continued down from the sides of the windpipe; insignificant in size; quite lateral, and terminating by being inserted into the middle of the outer surface of the second bronchial semiring.

Pitta cyanura differs from *P. angolensis* only in detail, not in plan of conformation. There are four instead of two syringeal bronchial semirings, to the middle of the last of which the single extremely feeble lateral muscle is attached on each side. In it also the last two tracheal rings, and not the last only, are incomplete behind, the last presenting a greater gap than the one above it. This syrinx is figured in Plate LIII. figs. 4, 5, & 6.

Pitta is therefore mesomyodian, in which respect it differs from all the known Old-World Passeres—although *Philepitta*, with its lengthy first primary, is most probably the same in this respect.

With reference to other points in the anatomy of the genus, it may be mentioned that in both *Pitta angolensis* and *P. cyanura* there is but one carotid artery, the left. The oil-gland is nude. The colic cæca are between one eighth and one tenth of an inch in

* P. Z. S. 1873. p. 463.

length; and the muscles of the thigh are similarly arranged to those of most Passeres, the myological formula * being *A,XY*, the *ambiens* muscle being absent, at the same time that the *flexor longus hallucis* is quite independent of the *flexor digitorum perforans*. The palate is beautifully figured by Mr. Parker in his memoir on *Ægithognathous* birds †; and I take this opportunity of giving a view of the back of the skull and of the sternum, which present features of interest. It will be noticed that the temporal fossæ extend across the occipital region of the skull, and nearly meet in the middle line behind; this condition, though frequently found in other families, is not one possessed by any Passerine birds except *Pitta*, as far as I am aware. Plate LIII. fig. 8 shows the sternum of *P. cyanura*; in it the sternal notches are particularly deep.

Menura superba is another bird in which our knowledge of the structure of the syrinx is very deficient. Mr. Eyton has described it ‡; but his account will bear supplementing. He tells us that "in addition to the usual sterno-tracheal muscles this curious bird has two other pair, both of which have their origin on the rings of the trachea on each side, at the point where it enters the cavity of the thorax. The anterior pair is inserted on the knobs at the extremities of the fourth bones of the bronchiæ; the posterior pair are also inserted on the bronchiæ, but on the three uppermost rings and on the posterior extremity of the fifth."

Several opportunities having occurred to me (partly through the kindness of Professor Flower in allowing me to dissect a specimen beautifully preserved in the Royal College of Surgeons, partly through the assistance of Mr. Edward Gerrard, and partly from my prosecutorial advantages) of dissecting the syrinx of *Menura superba*, I take the present opportunity of describing it in detail and figuring it.

In *Menura superba* the last sixteen rings of the trachea are peculiarly narrow from above downwards. These are carinate in front; in other words, instead of being flattened from without inwards (as is usually the case, and is so in the rings above the sixteenth in this bird), they are compressed from above downwards, by which means a sharp-edged ridge is developed, which projects outwards a short way beyond the level of the interannular membrane. The lowest of these rings, the last tracheal, whilst participating in this peculiarity, is modified to form the three-way piece, whence start the bronchi, an antero-posterior bar joining the downward-directed angles which are developed on the middle of the front and back of the ring, and supporting the syringeal semilunar membrane.

As in the typical Oscines, the first three bronchial semirings participate in the formation of the syrinx, and are modified accordingly, being stronger, deeper, more flattened, and more approximate than those which follow. The first of these is simple; the second is peculiar in being hollow and thin-walled, broader in front than behind, and broadest a short distance (about equal to its depth at the

* *Vide* P. Z. S. 1874, p. 111.

† *Trans. Z. S.* vol. ix. pl. lvi. fig. 6.

‡ *Ann. & Mag. Nat. Hist.* 1841, vol. vii. p. 49.